2

The Science Teacher

Published
October
December
February
April

A National Service Journal

The Science Teacher

VOLUME VIII | FEBRUARY, 1941 | NUMBER 1

Synthetic Rubber

E. C. HORNING*

University of Illinois — Urbana, Illinois

IN HERRERA'S account of Columbus' second voyage to the new lands, mention is made of the curious elastic spheres observed in the possession of some of the natives of Haiti. In May of this year the United States imported during the month about 50,000 tons of the same material that made up those spheres. But now there are better uses for rubber than bouncing balls; two-thirds of that importation will appear some time in the near future in the form of tires. There are many other uses for rubber, however, running all the way from rubber bands to the giant conveyor belts of the Grand Coulee Dam. Some of these uses are dispensable, or at least comparatively unimportant, but others are indispensable. There is perhaps no other material which has so subtly pervaded modern industrial civilization and which has over the course of comparatively few years become such a vital factor in maintaining that civilization.

Rubber owes its importance to its versatility and to its extraordinary toughness and elasticity. The properties of crude rubber are quite different from those of the finished product, and in between the two lies the art of rubber compounding. Crude rubber is elastic, but is quite soft and deteriorates rapidly if exposed to the elements. Vulcanization was discovered just a hundred years ago, in 1840, by Charles Goodyear, and with the discovery the foundations of the rubber industry were laid. Once it was realized that varying degrees of hardness could be introduced into rubber, and that it could be made tough and elastic and long wearing, new uses developed constantly. Since that time the methods of handling rubber have been subject to constant improvement, but sulfur vulcanization still forms the basis of most of the processes. It is this period of development that still faces most of the synthetic rubbers, even after preparative methods have been worked out.

Rubber, of course, is a polymer of isoprene (I). A polymer is a very large

$$\text{(I)}\quad CH_2{=}CH{-}\underset{\displaystyle CH_3}{\underset{|}{C}}{=}CH_2$$

molecule which is built up by the combination of many small molecules. The small molecules may be the same or different, and are called monomers, and the combination may be effected by many varieties of chemical reaction. The reaction may sometimes be reversed and the monomers obtained from the polymers. For example, isoprene (I) may polymerize to a linear or chain-like molecule (II). Thermal degradation will

$$\text{(II)}\quad {-}CH_2{-}CH{=}\underset{\displaystyle CH_3}{\underset{|}{C}}{-}CH_2{-}CH_2{-}CH{=}\underset{\displaystyle CH_3}{\underset{|}{C}}{-}CH_2{-}$$

return some isoprene, although the yield is low. The properties of the polymer are determined by its chemical and physical structure.

WITH THE development of organic chemistry during the nineteenth century, rubber came in for its share of in-

* Post doctorate assistant in chemistry.

vestigation. When the truth of G. Bouchardat's suggestion that isoprene was the mother substance of rubber became apparent, chemists began to divide their time between studying the structure of natural rubber and endeavoring to synthesize rubber or a rubber-like compound. Some of them were actuated simply by a desire to synthesize a complex natural rubber and endeavoring to synthesize rubber or a rubber-like compound. Some of them were actuated simply by a desire to synthesize a complex natural compound, but probably none of them were insensible to the possible economic consequences of a cheap synthetic rubber. It was thought, very naturally, that the properties of rubber were peculiar to its linear, unsaturated structure, and consequently the first laboratory polymers were prepared from dienes. Isoprene (I), dimethylbutadiene (III), and butadiene (IV) were all polymerized to compounds that were occasionally rubber-like in nature.

III. $CH_2{=}\underset{CH_3}{C}{-}\underset{CH_3}{C}{=}CH_2$ IV. $CH_2{=}CH{-}CH{=}CH_2$

THE COMMERCIAL development of these early polymers would probably have proceeded slowly had it not been for periods of tremendous economic pressure. Experimental results in Germany had shown little more than promise when the World War started in 1914 It was soon realized, however, that a rubber shortage was imminent and the great chemical firms were soon required to select the best available methods and to enter production. Dimethylbutadiene (III) (from acetone through a pinacol reduction followed by dehydration) was chosen as the most readily available starting material for a suitable rubber. At Leverkusen polymerization of the monomer was brought about by heat or by allowing it to stand in tin drums, while at Ludwigshafen sodium in an atmosphere of carbon dioxide was employed. Production was necessarily low, reaching for example 150 tons per month at the Bayer and Company plant (Leverkusen) but the facilities were being expanded when war ended. This material was the old Methyl rubber (H, W and B), but it was quite inferior to natural rubber. Its structure is shown in (V).

V. $\leftarrow CH_2{-}\underset{CH_3}{C}{=}\underset{CH_3}{C}{-}CH_2{-}CH_2{-}\underset{CH_3}{C}{=}\underset{CH_3}{C}{-}CH_2 \rightarrow$

After the war, interest in a synthetic rubber was more or less intermittent in nature although in Germany there was a considerable amount of sustained research. With the tremendous rise in price of natural rubber that occurred in 1925 (to more than $1.00 per pound), there was again a rush into the synthetic field. The price soon dropped, but this time the goal looked close enough to insure continuation of some of the work.

THE REQUISITES of a good synthetic rubber are many, but they may be reduced to two chief considerations: the material must be functionally capable of replacing rubber in one of its numerous capacities, and its price must be commensurate with its ability to carry out this replacement. Since economic factors play such an important part in the picture, it was realized that a cheap source of monomer was necessary.

Butadiene (IV) was early recognized as one of the most promising monomers. It can be obtained from a great variety of raw materials. Acetylene (from coke and limestone through calcium carbide or from petroleum by cracking) may be transformed easily into butadiene (through acetaldehye to aldol to 1,3-butenediol to butadiene).

$$HC{\equiv}CH \xrightarrow[Hg\ \ H_2SO_4]{H_2O} CH_3CHO \xrightarrow[base]{}$$

$$CH_3\overset{OH}{CH}CH_2CHO \longrightarrow CH_3\overset{OH}{CH}CH_2CH_2OH \longrightarrow$$

$$CH_2{=}CH{-}CH{=}CH_2$$

This process was employed in Ger-

many. In Russia alcohol from potatoes was passed over a hot catalyst and converted to butadiene. Since alcohol may be obtained from a host of organic materials, this method may be varied considerably with regard to raw materials. The greatest potential source, however, is the petroleum industry. Chemists have succeeded in obtaining butadiene from butane:

$$CH_3CH_2CH_2CH_3 \xrightarrow[\text{cat.}]{\Delta} CH_2{=}CH{-}CH{=}CH_2 + 2H_2$$

and this method of preparation is probably one of the cheapest.

Butadiene forms the basis of the German synthetic rubbers. Formerly polymerized by sodium, it was made in quantity under the name of Buna rubber (Bu for butadiene, Na for natrium or sodium). Now it is polymerized in an emulsion, as is all of the synthetic rubber of the United States, and mixtures of monomers are usually employed. When different monomers are polymerized together as in this instance, the result is a heterogeneous chain polymer known as a copolymer. Styrene (VI) is added to give Buna S and acylonitrile (VII) is added for Buna N (known in this country as Perbunan). Both were developed in Germany. The mechanized German army rides on Buna S tires. A superior abrasion and heat resisting faculty is claimed. Buna N is also an excellent rubber, and is resistant to hydrocarbon swelling.

VI. 

$$\text{VII. } CH_2{=}CH{-}C{\equiv}N$$

NATURAL RUBBER suffers from several disadvantages. It swells on contact with hydrocarbon solvents it is not extremely resistant to heat and it deteriorates with age. Some of the new synthetics are much superior to rubber in some of these properties, but as yet they all possess one disadvantage. Where the elastic properties of rubber come into play, some of the work done is converted into heat. This, of course, is bad for the rubber but impossible to avoid. Unfortunately, this conversion seems to be larger for the synthetics, at least so far as present products are concerned. It may be, however, that the synthetics will soon surpass rubber even in this capacity. The word synthetic is something of misnomer, inasmuch as synthetic rubber per se has never been prepared, but the connotation is obvious. It is quite possible, with the rapid rate at which developments are occurring, that substitutes which will be better than rubber for general uses will become available even as there are now synthetics which have replaced natural rubber for a few specific purposes.

IN THE United States the synthetic rubbers entered the picture about ten years ago, when Duprene, now Neoprene, and Thiokol were being developed. Duprene started with the researches of Nieuwland on acetylene. The du Pont Company became interested, and under the brilliant supervision of the late Dr. Wallace Hume Carothers a new rubber was constructed; it takes its place with the polyamides (Nylon) as one of the great practical developments arising directly by his efforts from the field of condensation polymerization, a field in which he laid down the theoretical principles in a series of papers over a period from about 1929 to 1933. This rubber is a polymer of chloroprene, or 2-chloro-1,3-butadiene (VIII) prepared from acetylene through vinylacetylene (a dimerization under the influence of cuprous salts)

$$\text{VIII. } CH_2{=}CH{-}\underset{}{\overset{Cl}{\overset{|}{C}}}{=}CH_2$$

followed by the addition of hydrogen chloride. The acetylene may be obtained from coal and limestone through the carbide process, and the hydrogen chloride comes from salt. After polymerization (again in an emulsion) and processing the product is a tough, elastic, rubber-like material resistant to hydrocar-

(Continued on page 34)

THE SCIENCE TEACHER

201 North School Street, Normal, Illinois

A Journal of
The Illinois Association of Chemistry Teachers
The Illinois Biology Teachers' Association
Indiana High School Chemistry Teachers' Association
Texas Science Teachers' Association
And Serving Other Science Associations

Entered as second-class matter January 30, 1940, at the post office at Normal, Illinois, under the Act of March 3, 1879.

Subscription rates: In the United States, $1.00 per year, or $1.75 for two years

ILLINOIS CHEMISTRY TEACHERS

The Illinois Association of Chemistry Teachers is embarking on a more active course, pointed toward an enlarged spring program and a summer conference for in-service teachers. Both these moves appear to be in the right direction and should have the hearty support of teachers of the state.

Spring Meeting. The spring meeting this year is planned for two days and comes Friday and Saturday, April 4-5, at Oak Park and River Forest High School in Oak Park. The program will be planned to meet the needs and interests of teachers.

Summer Conference. This summer an innovation in the way of a summer conference for chemistry teachers is being arranged by the association under the leadership of Mr. Soliday and in cooperation with the University of Illinois. Plans at present are not definite but indications are that it may include special programs to help teachers keep up to date on changing concepts in science and to help them in acquiring needed skills for science activities. This may well fill a definite need for a "refresher" course for teachers who do not find ti possible to spend a summer in school. At the university, Professor John Bailor of the Department of Chemistry, and Professor W. E. Harnish and Curtis Howd of the University High School are cooperating in working out plans.

This appears to be a worth-while venture and should have the hearty support of every member of the association.

OUR FRONTISPIECE

For our frontispiece we are indebted to the Missouri State Junior Academy of Science. The picture shows one of their outstanding exhibits at the Junior Academy meeting last spring. It concerns the testing of the flight characteristics of aeroplanes designed and built by a high school science student. For other pictures of the Missouri exhibit see a later page in this issue.

Opportunity Knocks Louder

JOHN C. CHIDDIX
Editor Science Teacher
Normal Community High School — Normal, Illinois

OPPORTUNITY may knock but once, so it is often said. But for the science teacher, opportunity has been knocking for years, and now under the stimulus of a program of national defense, it is knocking more insistently. The question is, are we fully aware of it?

The past year has witnessed much activity in gearing the nation to a program of national defense, in the schools as well as out. Representatives of numerous educational organizations met in Washington in September to determine how our educational resources may be mobilized behind a defense program, how we may better emphasize the values of our American democracy, and how we may improve opportunities in the direction of practical education for national defense.

Similar activities have been undertaken by the Educational Policies Commssion of the National Education Association and by the American Association of School Administrators. These responsible groups hope not only to build a vigorous faith in Democracy, but to promote a more functional program of learning that the products of our schools will not be found lacking under the supreme test of defense of home.

The Educational Policies Commission states:

"In the defense of American democracy our system of education must play the central role. . . . Education can help to clarify the nature and goals of democracy. . . . It can provide opportunities to live democracy in the school and the home, in the workshop and the market place."

THE PRESENT situation is such that each of us who teaches science should pause and give very serious consideration both to what we are teaching and how we are teaching it. We may well inquire if it is practical and if it is functional. Does it fit our students for citizenship and to meet intelligently life situations? Are we still laboring under the delusion that our principal objective is to prepare students for college? Material taught that does not function is dead and is a dead weight to the course. It handicaps an otherwise useful teacher and labels the course among students as one to be avoided.

Students quickly recognize values in what is taught. Recently a college student who had noted practical developments in a vitalized chemistry course remarked, "Why didn't they teach that way when I was taking chemistry? The course did not mean anything to me. It simply served to keep me busy and out of mischief." This may be rather severe judgment, but it may be merited in some cases. We need to question whether the criticism applies to us individually and to what extent.

INCREASING vitality in both method and content of courses may be illustrated by the new defense classes now coming into many high schools. These are established by the national government for those of draft age to fit them for better service. The courses are financed and planned by the government. Some of these are related closely to the science field. They provide us a pattern that we might well study to our own advantage.

Both the method and content of the courses are extremely functional in character. Each class is taught by a trained teacher of the high school staff and also by a trained practical man in the field. For example, the class in electricity has the benefit of working with

(Continued on page 28)

Science Fair

MABEL SPENCER

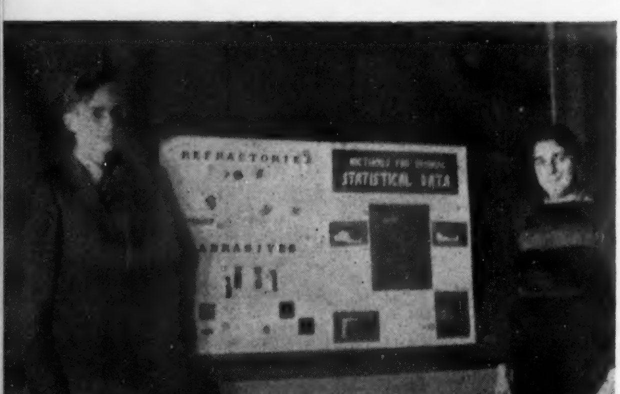
Granite City Community High School Granite City, Illinois

IF THE URGE to display your scientific wares lies deep in your heart, you should do something about it. You should build for yourself a Science Fair. The process is much easier than you have probably imagined. Everyone is interested in science, not passively, but actively, for are we not living in a scientific age? In fact, it is an age when we either step forward scientifically and economically, or we slide back — we can not stand still and survive.

In our school we had long desired to see a glass blower and this probably was the underlying inspiration for our Science Fair.

We did the usual study of literature and with the few helps we gleaned we decided that after all our Fair must fit our needs and our desires and abilities rather than those of some club in California or New York. Our next step was to sit in conference and list our assets. They were:

1. One active member of a Gas Model Airplane Club.
2. Two members interested and well acquainted with the field of photography. One alumni member who was a photographic supply salesman.
3. One orchestra member who was also a printer.
4. One very good artist.
5. Two potential electricians.



This seemed a fair variety, but was not quite sufficient, so we looked further. The gas model club and orchestra were requested to assist their representatives.

OUR FRIENDS and acquaintances were beneficial because of their interest and their varied qualities. Among them was Professor Charles Knipp from the University of Illinois, whom we asked to demonstrate liquid air. But we still wished a glass blower, and we were most fortunate to discover that Professor Knipp was an expert at glass blowing.

Our science department gave us full use of their facilities and our vocational shops and home economics department helped us in many ways. We even found among our friends an ornithologist hobbyist.

We found we had more than enough material for an evening's entertainment so we then organized our committees: (1) advertising, (2) decorating, (3) program, and (4) tickets.

Advertising

Our advertising committee started with a curiosity arousing stunt. About three weeks before the Fair, on a Monday morning, the school was dotted with about three hundred pupils wearing circular red tags Naturally everyone wished to know "why the tag?" On investigation, the tags were found to bear "Science Fair, Nov. 9th". Pupils came and begged to be allowed to wear a tag. Our mistake was probably in not making the purchase of a ticket prerequisite to the wearing of a tag.) Stories

of the coming Fair and its attractions were given to our high school paper and the local newspapers well in advance of the date. We received excellent newspaper publicity.

Decorating

THE DECORATING committee proved to be our best advertisers. After consideration of our general program ideas it was decided that Physics should be king for the day. Various physics motifs were discussed and finally it was agreed that our long narrow corridors could best be decorated with paper kites. Green and gold tissue paper kites were alternately hung from the light chains. (Green and gold were chosen because they were the colors of the Illinois Jr. Academy of Science.) The lighting effect was very attractive when the lights were turned on. Below each kite was hung a strip of cardboard which displayed in bold letters the name of some attraction. By the time a pupil had walked the length of the corridor he had seen each attraction advertised.

Two days before the Fair, scientific posters previously made by members of the club were hung on the walls of the corridors: blue prints of constellations, collections of wood and metals, flow sheets, water purification processes, and chemical trees. The most interesting was a set of posters using books as subjects: Eve Curie's "Madame Curie." and Carl Van Doren's "Benjamin Franklin" and "Men, Atoms and Stars."

Program

THE PROGRAM committee classified the attractions as being of two types: those which necessitated close observation and those which might be performed satisfactorily before large groups. The attractions for which closeness to display was a vital factor, were shown from 7:00-9:30. At 8:30 there was an assembly which all visitors attended.

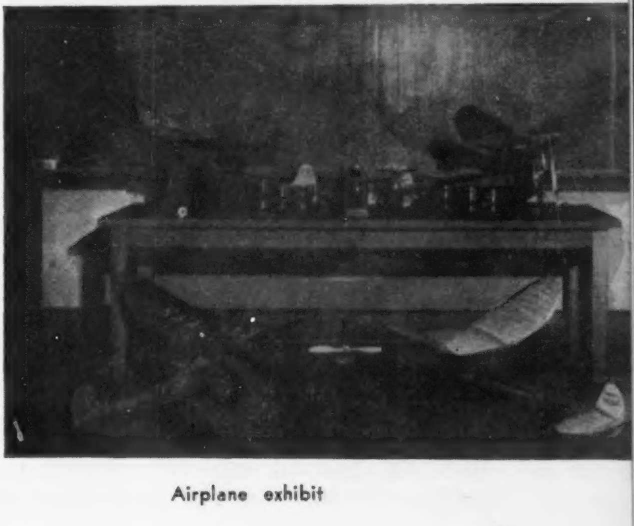
For the first attraction we featured glass blowing by Professor Knipp. This

Getting autographs from Professor Knipp

feature proved to be of immense interest to pupils and outside guests. The souvenirs which many obtained will be highly prized.

The Gas Model Club presented an airplane show which kept dozens of persons interested during the entire Fair.

Music was the hobby of our musical member, who secured his orchestra to demonstrate the difference between



Airplane exhibit

noise and music, pitch and loudness. The history of the development of musical instruments was given, starting with the simplest of homemade tom-toms and proceeding to complete orchestration.

Photography was the avocation of two members of the club, who secured a former member to help them in demonstrating photography: black and white, and colored. A large department store cooperated. Eastman's "High Light and Shadow" and a movie showing colored photography were shown after school for those who were unable to attend the evening performance.

ELECTRICITY had so enticed two of our members that they were studying to be electricians. They decided that the simplest of electrical equipment was not understood, so they showed the operation of: the electric fence, electrolysis of water, electro-plating, bell wiring, using of resistance to produce heat from electrical energy and facts concerning electric light bulbs. This was very interesting and informative to the crowds which gathered to see it.

The drafters made blue prints of guests' signatures, the machine shop gave high school souvenirs made on the punch press in their shop.

Chemical magic as performed by our magician included only the simplest use of indicators as: phenolphthalein, methyl red, methyl orange, and permanganate. This was intentionally a short program, but when we discovered what fascination it held for our guests, we realized the possibilities for such a program. An entire evening of such demonstration might easily be made up. Magic writing, pyrotechnics, and many common chemical reactions appear as magic to the average person.

THE BIOLOGY department had a child who identified birds from slides. One of our biology teachers also exhibited collections and the use of the microscope. A local teacher, who had ornithology for a hobby, trained a second grade boy in bird identification. Twenty of the most common and colorful birds were selected, such as: robin, meadowlark, bobolink, cardinal, etc. As each was projected on the screen, the child gave the name, the field markings of the male and female, its approximate size in relation to some bird commonly known to the audience. Nests, eggs and food were also discussed. The song was given. This child had an unusual interest in bird songs and could imitate many of them very well. After the slides were projected the child showed his audience some mounted pictures which we secured at the St. Louis Public Library. He stressed the more unusual side of bird life so far as an audience is concerned. If he discussed the common bird, his pictures illustrated the growth of the baby bird, the stealing of a nest by a cowbird. Among the illustrations of the uncommon birds were the red flamingo and its abandoned village of nests along a beach. Many unusual types of bird nests were also shown.

OUR HOME Economics department held open house. The foods department served a very delicious dinner for members of the faculty in honor of Professor Knipp. The clothing department showed pattern drafting and finished

(Continued on page 31)

Opportunity In The Junior Academy

JOHN C. AYRES

Normal Community High School — Normal, Illinois

The Junior Academy of Science has, within the last few years, enjoyed a phenomenal growth. Only a little investigation will show that this body is now nationally recognized as a junior partner to the accredited science bodies of the several states. In Illinois, the Junior State Academy of Science is an affiliated member of the Illinois State Academy of Science and is recognized by the American Association for the Advancement of Science. Each year some outstanding student member of the Junior Academy is given recognition as a delegate to the national convention as well as a year's subscription to either the "Scientific Monthly" or to "Science."

The Junior Academy of Science is an organization created for the purpose of stimulating interest in science among high school pupils. It offers a wholesome means of competition for the student who likes practical work in addition to theory. Every year at some host city there is a meeting of the Illinois State Academy, and at the same place the State Junior Academy has an exhibit of outstanding work done by high school or junior high school members. The only requirement for entering an exhibit is the ten-cent membership dues that are required for club entrance in the Junior Academy.

Aside from attendance at the exhibit itself, the value of a number of students engaging in practical and competitive science work is great. With fields of competition including models, projects (commercial and purely scientific), notebooks and radio notebooks, news letters, posters, and collections, an opportunity is offered for a student to excell in some one field of endeavor. This, in the writer's opinion, is ample reason for club participation.

There are many pupils who may not do as well as their classmates in discussions or tests, but who can master the basic fundamentals through the use of models or projects. This type of student will want to create something of value if encouraged and given the proper recognition. And not only does this effort on the part of one student help that student, but it helps all of his classmates as well. With several working models or projects to stimulate interest, class response seems "to pick up" and the subject becomes more dynamic.

The project is equally valuable as a learning device. Other students, upon becoming interested in the type of work that one of their number is doing, want to try something for themselves. With a few students "putting science to work" and asking each other questions, a new well of information is circulated freely and with enthusiasm.

Many high school students are capable of preparing exceptional notebooks but are content with one that is just acceptable unless some worth-while incentive is offered. An unusual chance to display work of this nature in state competition is given at the notebook exhibit. Certificates of award and publc recognition are given to those who excell in this division (as well as in each of the other fields).

A new angle is the radio notebook based on science programs on the air. This helps the individual to use the air waves as a source of scientific knowledge. As there are many valuable programs given regularly by the Smithsonian Institute, the American Museum, state museums, colleges, and other organizations, as well as private concerns,

(Continued on page 33)

*Chairman of exhibits, Illinois State Junior Academy of Science.

Science for Society

EDITED BY JOSEPH SINGERMAN

A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Some Observations on Technological Unemployment

"Certainly this is no time to stop thinking about the social and economic problems which are the root causes of the social revolution which is today a supreme factor in the world." With this, it appeared to me, the President offered a challenge, not alone to the Congress of the United States, but in particular to the administrators and dispensers of education throughout the land. This is by no means an easy task, what with the intense emotionalized appeals by radio, press and screen for realization of the other aspect of the appeal of our national executive. We who hold the faith of our youth will enlighten and guide them along a difficult path. Let us say to our young boys and girls that we will keep our trust with them. Their faith in hte ultimate "enjoyment of the fruits of scientific progress in a wider and constantly rising standard of living" should be placed on a firm foundation. This is among "the simple and basic things that must never be lost sight of in the turmoil and unbelievable complexity of our modern world. The inner and abiding strength of our economic and political systems is dependent upon the degree to which they fulfill these expectations."

OUR PROBLEM is how to explain the blessings of science to a youngster — and there are millions of them — who comes to us from a home over which hangs the spectre of unemployment or the torment of below-subsistence-level income, ostensibly brought on by application to farm and industry of the marvels of modern science? Machines, applied science, often take the brunt of attack as causes of this anomaly. For, does not a single automatic machine today displace fifty glassblowers? In nine years, it is claimed, the cost of assembling an automobile door has dropped from four dollars to thirty cents, a major portion of the saving being represented by labor economy. The more than a million and a half tractors, together with trucks and automobiles, have resulted in 1938 in the saving of some billion man hours of labor. Science, for many of our people, has given us on the one hand "surpluses" of necessities and comforts of life, and on the other hand an intensification of poverty.

IT IS RECOGNIZED that technological innovations are of first import in direct causes of unemployment and industrial displacement. While factory production in 1929 was more than three times that of 1899, employment gained by only 59%. At the same time, man hours required per unit of product was almost halved, so that productivity, or actual output per man hour, was nearly doubled. There was a further increase of almost 20% in 1938. But, in that year, man hours of labor provided by industry were only 97% of that in 1899. The effect of the increase of population, partly offset by that of limitation of hours of labor, resulted in an unemployment figure around 10 million in 1938.

Indirect impacts of technology upon labor result from economy in the consumption of material and fuel, and from the development of substitute materials.

Industrialized Agriculture

TECHNOLOGICAL impacts upon the farm population have been just as marked as those upon urban workers. In some instances, the effects have been even more deplorable. In hearings before the Temporary National Economic

Committee, Paul S. Taylor of the University of California, testified, "In West handle, and the southwest corner of Oklahoma, consolidations of cotton farms Texas, the Black Wax Prairie, the Pan- and displacement of substantial tenant farmers is proceeding rapidly. Landlords replace their tenants with tractors and hired laborers." The resultant of a continual shifting of a few millions to and from the farm is an effective annual migration of several hundred thousand to the cities. Agriculture is being industrialized; but it is posible that the impacts in this field of technological innovation are more severe in their effects because of the inability of farm labor to adjust itself as industrial workers can through their use of collective bargaining. Thus, as pointed out by Louis H. Bean, Counselor to the Bureau of Agricultural Economics, surveying the past twenty-five years, which included three periods of sharply rising national income, "Year in, year out, the nation consumes a remarkably stable per capita quantity of food."[1]

An Economic Problem

ONE MAY well question why it is that while the application of science has made possible an increased production of the necessities and comforts of life, some 45 millions of our fellow Americans are in want. So far as the consumption of food is concerned, Bean points out "that during these periods of rising national income the general level of food prices also rose and thus contributed to the relative stability in food consumption."[1] As this would lead one to suspect, rising national income has brought no noticeable benefit to those whose consumption of food is inadequate, those of the lower income levels. Even in the prosperity year of 1929, "almost three quarters of the people lacked sufficient income to buy conveniences and luxuries, and nearly one fourth of all American families, with incomes of less than $1,000, were unable to buy any but the barest necessities of life."[2] (This is an understatement.)

The benefits of technological progress have been available to a progressively smaller group of enterprisers. The TNEC points out: "The Brookings Institution studies on the formation of capital concluded that saving of money does not in itself create a demand for capital goods; that expansion in production is possible only if the market for goods is expanding, and an expanding market depends upon increased consumption demand."[2] The bank savings, which represent a portion of the wealth of upper income groups, thus constitute idle wealth which limits national consumption. Another form of such idle wealth is indicated by the enormous accumulation of undivided, untaxed corporation surpluses. "From 1929 to 1938 . . . Unused surpluses on deposit in banks rose 262 percent."[2]

IT MUST be borne in mind that any measure of recovery realizable through intensification of the national defense program will be shortlived, and, as will be pointed out in a subsequent article, the ultimate cessation of this program has the possibility of precipitating a social-economic collapse of a severity and magnitude unprecedented in American history.

It should be pointed out to the bewildered inquirer that science is not responsible for technological unemployment; that "the enjoyment of the fruits of scientific progress in a wider and constantly rising standard of living" is within his reach; and that failure to realize this enjoyment is due only to the failure of society to avail itself of the potential democratic benefits of science.

1 Louis H. Bean address, Dec. 6, 1940, to American Society of Agronomy, Chicago, Ill.

2 Report of Temporary National Economic Committee, Monograph No. 20, 1940.

Science Clubs at Work

EDITED BY KARL F. OERLEIN

State Teachers College **California, Pennsylvania**

A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

The Carbon Arc

SAUL W. GREENWALD

Senior Student

Uniontown Senior High School **Uniontown, Pennsylvania**

(Ed. note: Saul is a senior this year in the Uniontown high school. This paper was presented at the state-wide meeting of the Pennsylvania Junior Academy of Science last spring.)

THE CARBON ARC, more commonly called the electric arc, consists fundamentally of a quantity of insulated copper wire with two carbone rods to complete the electric circuit. By putting the carbons into a heat-resisting box (which I converted from an old flower pot) an electric arc furnace is formed. A rheostat, used to cut down on voltage and to increase the current, completes the equipment. The rheostat also makes the experiment safe by preventing any fuse from blowing.

The ancestor of the electric arc, invented in 1800 by Sir Humphry Davy, might also be called the father of the modern light bulb, for it was the first electrically produced light by man. At the time of its invention Davy used two thousand simple electric cells to produce the electricity for the arc. Charcoal rods which volatilized, or changed into a gas very rapidly, were used in place of the carbon rods. So it is easily seen that at that time the carbon arc was expensive, inefficient, and impractical.

THOMAS A. EDISON used the principle of the carbon arc to practical advantage in his inventions of the light bulb and the motion picture machine. Later, when man tried to improve on nature and to make artificial gems, the carbon arc was used to produce the intensely high temperatures necessary to liquify pure carbon and iron for the making of diamonds.

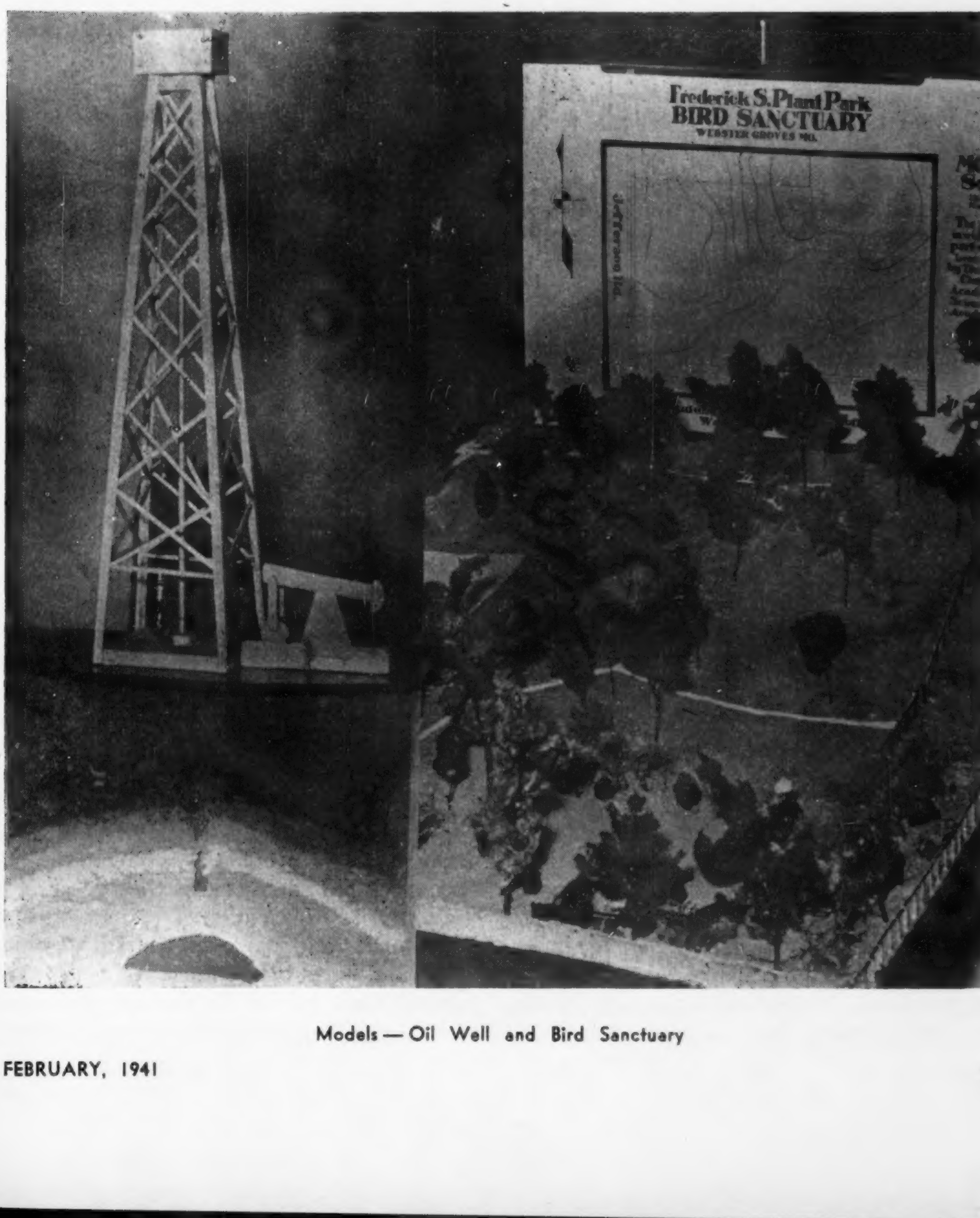
Electricity in passing through the carbons meets with a high resistance, and where energy is lost, heat results. No great heat or light is made when the rods touch, because electricity is conducted by the carbons. But when they are separated a quarter of an inch or so the light becomes blinding; the heat soars rapidly and is capable of volatilizing all substances known to man. Before being separated, however, the last bit of connecting carbon is changed into a gas, the gas conducting electricity across the gap. As the rods are separated, the heat increases as the resistance increases un-

til temperatures of from 3500 to 4000 degrees centigrade are reached. To give you are example of this heat, copper and tempered steel wires volatilize so rapidly

(Continued on page 36)

Missouri Junior Academy of Science Exhibits

Above — Project on Heredity



Models — Oil Well and Bird Sanctuary

Making Science Facts Stick

ADDISON LEE

Austin High School — Austin, Texas

ACCORDING to Josh Billings, ducks may be adequately characterized as follows:

> "The duk is a kind uv short legged hen. They kan sale on water as natral and easy as a grease spot. Duks have a brawd bill which makes 'em able tew eat without enny spoon. There aint enny more room on the outside uv a duk fer enny more feathers. The duk don't kro like a rooster, but quaks like a duk."

A zoologist would hardly approve of Josh's description of this member of the class Aves; however, I have noticed that the description, for obvious reasons, will stick in the high school student's mind. Any teacher would find it an easy task to extend the above description to cover the external and internal anatomy of this bird. Mimeographed copies could be distributed to students to help make the class "bird-anatomy" conscious. It would not be desirable to extend this particular technique to all learning situations. Styles change in all things, and one principle of pedagogy is to stay out of ruts. Another technique follows.

The stage is being set for a study of osmosis. The permeability of membranes must be explained. As the teacher presents a verbal definition, he passes back and forth through a doorway several times. "This wall," he explains, "is permeable to me at this point." As he backs up to the blackboard he explains nonpermeability. Similar dramatizations can be devised to explain a semipermeable membrane.

A TEACHER attempts to put over the idea that plants make their own food. After preliminary questioning designed to show that plants do not get their food from the soil, the discussion might proceed as follows: "Most of you are familiar with the way higher animals secure their food. Mother buys a bag of groceries. Father pays the bill. Mother applies some heat to some of them. You add pepper and salt and eat them. Plants can't do that. Are they less fortunate than we? No! Perhaps they are even more fortunate. They make their own food. Intelligent as we are, we can't do that.

Think how different the world would be if we could make our food. Imagine the number of stomachs that would be over-burdened with chocolate sodas. Think of the money that boys would save on dates. Just tell your girl to go ahead and make her thick malt—you will get by on a limeade. But, of course, it just doesn't happen that we can make our own food. But plants can. Their menus are slightly different. So is the menu of a cat different from that of a lizard. Even so, the basic food types are about the same. And so on. A bit melodramatic? Yes. However, the students will retain the idea that plants make their own food.

THE PROBLEM this time is to get started on the subject of digestion. The teacher calmly slices an apple and eats it. By the time this action is finished, the students certainly have their attention on the teacher. To begin the lesson, he asks: "John, what is happening to the apple at this moment?" The teacher has caught the attention of the class and the pupils have a problem situation set up before them. A dramatization by the pupils might be: "The fate of the roast-beef sandwich."

It is not my desire to see the science classroom turned into a vaudeville or a gag-pulling contest, but I believe that many teachers of science would be more successful in delivering the goods, if they would descend from pedagogical high-horses and discover that most children find it more comfortable to ride ponies. One way to do this is to change your style of teaching from time to time.

Free and Inexpensive Science Teaching Aids

WILLIAM A. BETTS

Austin High School Austin, Texas

(Continued from October, 1940 issue)

The teaching aids listed herewith may help science teachers in many ways. Their careful study will reveal many new industrial and domestic applications of pure science principles. The majority of the visual aids were prepared under the guidance of specialists in education and will make science more concrete and meaningful for many students. All booklets listed will be valuable additions to the science classroom library. Science exhibits, attractively arranged and conspicuously placed, will secure the attention of the entire school building population. Science teachers who make liberal use of modern teaching aids need never ask their students to "drink from a stagnant intellectual pool."

Use school stationery when writing for these materials, and enclose personal check or coin as payment for aids not listed as free.

The Story of Leather (80 pages, 40 full-page illustrations) provides a picturized trip through a modern leather plant. Use of chemcals in leather treatment is fully explained in the language of a layman. Issued free to teachers by the Ohio Leather Company, Girard, Ohio.

Many chemistry and botany teachers have found that a study of paper manufacture serves to illustrate the useful application of several science principles. The Advertising Department of the Hammermill Paper Company, Erie, Pennsylvania, offers a science exhibit entitled "The Making of Hammermill Bond," which includes pictures and specimen jars of spruce wood chips, pulp, bleached pulp, and colored pulp. A service fee of one dollar is charged by the company.

The Story of News Print Paper (75 pages, 15 full-page illustrations) relates in detail the operations involved in making news print from spruce of the north woods. Published by The News Print Service Bureau, 342 Madison Ave., New York City: $1.00.

Care of the Feet (31 pages with several illustrations) presents reliable information about foot health, footwear, and home treatment of foot troubles. Price 10c. Address: Frederic J. Haskin, Director, Haskin Educational Booklets, Inc., Washington, D. C.

Corn in Industry (63 pages) is a handbook of information on the starches, syrups, sugars and other industrial products made from the corn kernel; including a brief historical sketch about corn. Interestingly written and well illustrated. Free to teachers and others interested. Write to the Corn Industries Research Foundation, 270 Broadway, New York City.

Let your more promising chemistry student learn more about dyes. Write for "Dyes, . . . A Few Facts About Their Uses, and Place in American Industry" from the E. I. Du Pont De Nemours & Co., Inc., Organic Chemicals Department, Dyestuffs Division, Wilmington, Delaware.

The Story of Flour consists of a wall chart (38 x 50 inches, two colors) and a 44-page, well illustrated booklet describing the process of wheat growing and flour milling. Send 50c to cover cost of mailing to Pillsbury Flour Mills Company, Minneapolis, Minnesota.

For more information on the subjects of match history and the chemistry of match making write for "Matches." Free to teachers. The Palmer Match Company, Akron, Ohio.

Chemistry and general science teachers can make use of "The Story of Copper and Its Alloys." Free. Copper and

Brass Research Association, 420 Lexington Ave., New York City.

"The Story of Aero Cyanamid" is the story of nitrogen from the air. This 16-page booklet would be interesting to chemistry teachers and students. Well illustrated. Free. American Cyanamid Company, 30 Rockefeller Plaza, New York, N. Y.

Chemistry and Biology teachers will be interested in the following teacher and student aids on the manufacture of rayon:

(1) The Story of Rayon, a 96-page, bound, well illustrated book. 50c.

(2) Educational Kit showing samples of the 7 stages in the manufacture of rayon from wood chips. 75c.

(3) Wall Chart and 40 Student Leaflets. 75c.

(Continued on page 38)

NEWS NOTES FOR TEXAS TEACHERS

THE TEXAS Game, Fish and Oyster Commission has prepared several color films showing Texas wild life in action. All films are of 16 mm silent type. Those most useful to science teachers are listed below:

No. 891 Wild Life of South Texas, 2 reels; $1.00 per day.

No. 892 Some Birds of Texas, 1 reel; 50c per day.

No. 893 Trapping Turkeys in Texas, 1 reel; 50c per day.

No. 894 Wild Life West of the Pecos, 1 reel; 50c per day.

No. 895 Mammals on Wings, 1 reel; 50c per day.

No. 896 Let's Go Fishing, 1 reel; 50c per day.

American supplies of natural rubber might be cut off in event of a war with any eastern power. Du Pont presents the fascinating story of chemical rubber—neoprene. Keep your chemistry students posted on world science events. Show them:

No. So 1284—The Story of Neoprene. Twenty minutes. A free sound picture. 16 mm.

Any or all of the films listed above may be obtained from the Visual Instruction Bureau, University of Texas, Austin.

The Texas Association of Science Teachers elected the following officers to serve it for the 1940-41 year:

President, Jack Hudspeth, Austin, Texas;

Vice-President, J. B. White, Forest Ave. High School, Dallas, Texas;

Secretary-Treasurer, Greta Oppe, Ball High School, Galveston, Texas;

Editor of Publications, William A. Betts, Austin High School, Austin, Texas.

Texas science teachers will be especially interested in reading about "New Phases of Industrial Expansion in the South," an article in the December 1940 issue of The Texas Outlook. The author was Sue Bates of the Galveston Public Schools.

DISTRICT MEETINGS FOR TEXAS TEACHERS

MANY TEXAS science teachers are accustomed to attend the district meetings of the Texas State Teachers Association. We are reliably informed that there will be a well-planned science section program at each district meeting. Plan now to attend. Meeting places and dates are given below:

District 1	Houston, March 13-15
District 2	San Antonia, March 7-8.
District 3	Laredo, February 13-15.
District 4	Big Spring, Mar. 14-15.
District 5	Mineral Wells, March 14-15.
District 6	El Paso, March 13-15.
District 7	Wichita Falls, March 14-15.
District 8	Tyler, March 7-8.
District 9	Canyon, March 14-15.
District 10	Austin, March 7-8.
District 11	Brownwood, March 13-14.

Radio Demonstrations In General Science

HERMAN SCHNEIDER
Student
Grover Cleveland High School
New York, New York

SINCE THE RADIO has come into such general use among people, it appears very desirable that some understanding of it should be presented in the high school general science course. Some of the principles can easily be presented in an elementary way at this grade level. The apparatus for them is very simple to build and is inexpensive. The demonstrations, however, can be used very effectively in a general science classroom. They are intended to give some idea of radio waves, radio reception, and the function of a condenser.

RADIO WAVES

Apparatus

The apparatus required for demonstrating radio waves consists of the following:

1 Ford induction coil	$ .90
4 dry cells (6 volts)	1.00
1 neon tube, 2 watt	.35
1 neon tube, 1 watt	.35
2 nails and clips to act as a spark gap	
2 antennas—made with dowel sticks	

IN MAKING an antenna from two dowel sticks, first drill or nick twenty holes in each stick about one inch apart and then fasten the sticks crosswise of each other. The loops are formed by drawing bell wire through the holes as indicated in the diagram. Ten turns of wire are placed on the receiving antenna and five turns on the transmitting antenna. Place a two-watt neon bulb in series with the receiving antenna. The arrangement of the apparatus is shown in the diagram. (Fig. 1.).

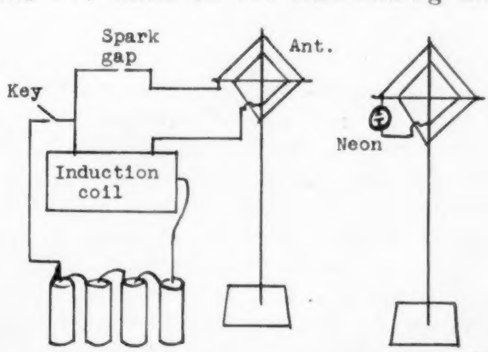


Fig. 2. Radio Wave Apparatus

Operation

1. Set the nails about one-eighth inch apart so that a spark may jump the gap on depressing the key. Set the receiving antenna parallel and about twelve inches away from the transmitting antenna. Depress the key and note that the bulb lights up.

2. Increase the distance between the antennas. The lights become dimmer.

3. Turn the receiving antenna at right angles to the other. There is no reception.

4. Place the 1 watt neon lamp near either antenna without touching it. The bulb lights up.

Explanation

WE HAVE HERE an actual radio transmitter and receiver on an elementary plane. The high voltage spark across the gap produces a high frequency radio wave. The transmitting antenna acts as the radiator and the other antenna acts as a visible receiver. When radio waves from the transmitting antenna cut aross the wires of the receiver, we have an induced current produced in it. No such current is produced if the antennas are at right angles to each other. The one watt lamp needs no antenna since the small power received by it (by induction) is sufficient to ionize the enclosed neon gas and produce light.

Outcomes

1. A spark may be used to produce radio waves.

2. The strength of the wave varies with the distance.

3. The antenna is used to collect, concentrate, and radiate these waves.

(Continued on page 28)

Time To Retire

DAVID D. APTEKAR

Northwestern High School Detroit, Michigan

(Is it "time to retire" or renovate our teaching of high school chemistry? A more rational approach to the development of subject matter seems a need of the day.)

LET'S START with a story! Fifteen years ago, a young student sat in his chemistry class and made an acquaintance with the wonders of science. He was given a list of definitions so that the language of the text would be more understandable. Next, he learned to differentiate between elements, mixtures, and compounds. This was followed by a study of oxygen, hydrogen, and water—in that order. The second semester began with a study of carbon, and was followed by sulphur.

Thirteen years later. This student has moved up to the front of the room, to the tecaher's desk, in fact. As a new teacher, he has just opened the text which he has been asked to use. It starts with a few definitions, differentiates between elements, mixtures, and compounds, follows with oxygen, hydrogen, and water—in that order. The second semester begins with a study of carbon, is followed by sulphur. Shades of Joseph Priestley! Is this reincarnation, or is this strange familiarity of material really due to a remarkable standardization of development of subject matter? Is this pure coincidence, or could it be true that chemistry teaching was in a rut, that it hadn't changed appreciably in the past decade?

Hastily, he scans through other "new" books. A study of over a score of these "modern" college preparatory texts reveals an appalling "sameness." It is as though our books were cast from the same mold. Someone had apparently figured out the most logical sequence of development of the subject, and many other authors hastened to follow Some even used practically the same phraseology, so fearful were they that they might deviate from the pattern.

Let's leave our story now, and study this standardization of textbooks. It we analyze the sequence of material from the point of view of the teacher, we can easily see that there is much to be said for the traditional development. The material is usually presented in an increasing order of difficulty. It is logical, too, in that each new concept is made more understandable because of principles already learned. This is as it should be.

ONE GROSS ERROR, one outstanding weakness is found with this arrangement which needs correction. While we have developed our material from the point of view of increasing difficulty of principles, we have utterly neglected to consider continuity of subject matter. It might be clear to us who already understand chemistry why we arrange our material as we do. But what of the student? From his point of view, chemistry is a study of a group of unrelated chapter headings. He wouldn't know calcium from carbon if he met them on the street, and he can't see why the chapter on aluminum follows sulphuric acid. From his point of view, we could just as well study sudphur before ionization, or vice-versa, or what difference would it make anyhow? The point is, the chapters of our text, despite their conformity to pattern, seem unrelated one to the other. Such a development is weak in that the subjects studied, as well as the technical names by which they are identified, are not always common to the experience of our students. The heading "Acids, Bases, and Salts" has no significance to them because it has no reality in their personal experience. The "Halogen Family" might be related to the Bourbon's as far as the beginning student in chemistry might know. We must divide our subject matter into materials with which they are familiar.

By doing this, we will make a study of chemistry something real and worthwhile, because we are studying materials in **their** world. Manifestly, their interest will be intensified because we are relating their learning to familiar fields. Chemistry will be worth studying because it will help find answers to some questions about the earth and life which have been puzzling them.

IN MY OPINION, a more logical development of a course would start with student interest. Concepts would be woven into the course as they evolve from the need for understanding them. Concepts would be taught as they are necessary to the understanding of the subject under discussion. This is the reverse, is it not, of the present technique of development? I would start with the study of a few essential raw materials with which we are all conversant,—air, water, coal, wood, petroleum, salt, limestone, metals, etc. These are the materials from which all chemical industry evolves! From this handful of familiar substances the ingenuity of man has produced many things. First, he broke down some of these materials into simpler ones, creating new products. By clever combinations he produced additional substances, many of which are familiar to us. Fertilizers, drugs, cosmetics, synthetics, dyes, and many other substances are produced from the original few by chemical methods.

From such an approach, it is not difficult to see a continuity develop in our course. Everything in our study evolves from a handful of common materials, and what can be done with them. There is a reason for studying these materials. The sequence of study of their secondary products and end products becomes apparent and intelligible. The language, principles, and laws become necessary for understanding. They are appreciated as results of man's efforts to utilize the immediate substances of his surroundings. The desirability of mastering them becomes a keen need as a comprehension of man's cleverness unfolds. Each chapter becomes part of the whole, another peg in the course of explanation.

SUCH A COURSE is flexible. For college preparatory students it is possible to introduce the regular concepts of valence, formulas, equations, and problems. For general students, you can omit the quantitative aspects, and stress the practical. Whether your needs are those of the industrial city, the agricultural school, or the universal needs of the consumer, you may study from such an approach without sacrificing continuity, or omitting what you consider to be essential information.

I am submitting an outline to help picture how such a course might take shape. Each of us will want to draw from our experience, and either add new points, or substitute for ones here listed. Our use of the outline can be determined by our needs. The main thing is that here is a new approach to the teaching of chemistry. It pictures clearly how industry has grown to its present status, and indicates that new combinations are yet possible. It tells the story that our progress in utilizing our environment is limited only by our ability and desire to study chemistry—the science of materials in our environment.

LET US remember that our courses are really for the benefit of the student, not the teacher; we must always evaluate them to determine how well they fill their needs, not ours. We started with a story. We believe this is a story worth thinking about. How it ends will be determined by your careful evaluation of the theme.

Is it **time to retire** the traditional approach? Is a more rational approach to the development of our courses in chemistry desirable? Study this outline, and then take inventory!

Let's not stay in that rut too long!

A Double Check Bird Chart

P. D. HOUDEK

Robinson Township High School Robinson, Illinois

TIME TO start bird study. If you are a real bird enthusiast, you have by this time started with the winter birds and have a good list in the records of your students. If, on the other hand, you, as most of us, feel that bird study is a spring project, you are getting ready to start and will soon devote at least part of a class period to opening up the subject.

A good chart to record the observations of your students where others can see them will play an important part in this project. Each student should keep his own records, but a large chart will add interest all spring. The chart proposed below serves two purposes. First, it is possible at a glance to check the number of birds observed by each student, and second, it is possible to check on the frequency that each bird has been seen. This last is some indication of the frequency of that species in your community.

In planning the chart, it will be necessary to plan enough horizontal lines to assign one to each student and enough vertical lines to have one for each of the species that you expect will be observed. The top of each vertical line should slope to the right above the space for the first student at an angle of about 45 degrees. On these sloping lines should be printed the names of the birds in the order in which they are observed by members of the class. This provides a ready list of the birds that have been observed to date.

EACH STUDENT records the birds as he sees them by placing the date (3-17 to indicate March 17th, for example) in the square where his line crosses the line for the species. With this in mind, the spaces should be large enough to give room to write in the numbers for the months and days. To create interest, reward observing students and prevent errors due to over-enthusiasm, it is well to permit any student seeing a new bird to write the name in the next space only after he has reported to the class giving a brief description of the bird and an account of where and when he saw it. If small pictures of the birds are available, it adds a lot to post the pictures of each new bird near the record chart.

FORCING LILIES OF THE VALLEY

THIS IS one of those almost sure-fire projects that will create a lot of interest for your students and others who come into the biology laboratory. Another feature is that it is possible to do it with no cost other than some work and care.

Secure an old dishpan, small tub, round cheese box, or other rigid container at least a foot across and six inches deep. Next find someone who owns a bed of lilies of the valley and who is willing to donate a small section of it to the project. Invert the container over the bed and mark around the edges. With a sharp spade remove a chunk of the bed that will fit the container with an inch or so to spare at the top. Be sure that there are holes in the bottom for drainage, place the transplanted bed in a warm room with good light, water and turn daily (after plants come up).

After the flowers are withered, the plants can be kept going until it is possible to set them back into the bed or in another place. If the plants are not to be returned, the hole in the bed should be filled with good soil when the shunk is removed. N.B. This project can be started even though the bed is frozen solid.

Some Adolescent Health Needs and How to Meet Them

LYNDA M. WEBER

University of Wisconsin High School — Madison, Wisconsin

(This article is based on the philosophy and the results of a four-year experiment in "Functional Health Teaching," directed by the writer in nine progressive cosmopolitan high schools in and about Chicago. The project was carried on under the sponsorship of the Curriculum Commission of the North Central Association. Typical examples of methods of procedure, as developed in the various participating schools, are given to illustrate phases of the general philosophy discussed in the article.)

WHAT KIND of health knowledge is essential to the adolescent of today? How can health knowledge be presented so as to bring about effective results?

These are the two questions the writer will attempt to answer in the light of a review of recent investigations concerning needed health training; and in accordance with the classroom methods found most effective in the writer's own experience, and in the experiences of ten or twelve other health teachers observed at work in their classes. Due to the brevity of this article, only personal living problems will be discussed; although health in relationship to the social, civic and economic aspects of life will be touched upon in connection with the personal living problems. It is difficult to separate these aspects from each other, and it seems doubtful whether they should be kept distinct in our health training.

Kinds of Health Knowledge Important to the Adolescent of Today

"The criterion for the selection of teaching material is not the effectiveness with which it summarizes the known body of knowledge in the field but rather the degree to which it affects the adolescent's choices, actions, and attitudes"[1]

[1]*Science in General Education,* Commission on Secondary Education, D. Appleton Century Co., 1937, p. 67.

ALONG WHAT lines do the "choices, actions, and attitudes" of our adolescents need direction at the present time? We can determine by making careful studies of national, state, and local mortality, morbidity and general health statistics and reports; life insurance health reports; clinical reports; physical examination reports of pupils in elementary and secondary school systems, and of freshmen entering our colleges and universities; etc. We can gather further information from the investigation reports of educational leaders, health directors, and consumer education leaders. Much of this information is now being summarized and clarified for us in our health magazines and in educational reports.[1]

[1]The following references will be found valuable in this connection:

Periodicals:

(1) *Hygeia,* The Health Magazine (Monthly), American Medical Association, Chicago, Ill.
(2) *The Journal of the American Medical Association* (Weekly), American Medical Association, Chicago, Ill.
(3) *Journal of Health and Physical Education* (Monthly, except July and August), American Physical Education Association, Ann Arbor, Michigan.
(4) *The Journal of School Health* (Monthly), American Association of School Physicians, Albany, New York.
(5) *Public Health Report* (Weekly), United States Public Health Service, Washington, D. C.
(6) *Public Safety* (Monthly), National Safety Council, Inc., Chicago, Ill.
(7) *Safety Education* (Monthly, except July and August), Education Division, National Safety Council, Inc. New York City.
(8) *Venereal Disease Information* (Monthly), United States Public Health Service, Washington, D. C.

Pamphlets: (Send for list of available bulletins)

(1) American Association of Medical Social Workers, 122 East 22nd Street, New York City.
(2) American Heart Association, Inc., 50 West 50th Street, New York City.
(3) American Medical Association, 535 North Dearborn Street, Chicago, Ill.
(4) American Public Health Association, 50 West 50th Street, New York City.
(5) American Social Hygiene Association, Inc., 50 West 50th Street, New York City.
(6) Consumers' Research, Washington, New Jersey (Bulletins and Yearbook).
(7) Consumers' Union, 55 Vandam Street, New York City.

(8) Life Extension Institute, 25 West 43rd Street, New York City.
(9) Metropolitan Life Insurance Company, 1 Madison Avenue, New York City.
(10) National Committee for Mental Hygiene, 50 West 50th Street, New York City.
(11) National Education Association, 1201 16th Street, N.W., Washington, D. C.
(12) National Safety Council, 20 North Wacker Drive, Chicago.

After studying these reports, it becomes obvious that among the main topics of personal living which our rising generation need to understand more thoroughly are: diet, exercise, posture and rest; pathogenic organisms; drugs; endocrinology; allergies; reproduction and heredity; safety education and first aid; consumer education concerning the health wares on the market; and mental hygiene.

IT IS NOT necessary to present all known knowledge on any one of these topics to the adolescent. What he needs is an understanding of such aspects of them as will influence him to modify his "choices, actions or attitudes" intelligently and self-consciously now and in the future. The health director should sift out for him the information that will help him to attain and maintain his own physical health. When the problem of diet is presented, for instance, it is essential for him to learn, in addition to such facts as have been known for many years, the importance of new discoveries of the relationship of diet to growth, general vitality, disposition; complexion, and resistance to disease.[1] Such information is of direct use to the adolescent.

He must be given sufficient information concerning recent reliable discoveries to cause him to evaluate and to modify his former actions and practices, if the discoveries indicate that such modifications are wise. He should be made to appreciate that the present understanding of specific health practices may be changed with new discoveries, and that it is essential for him to remain open-minded at all times. He should be taught how and where to find reliable information on any health subject. He should be made aware of false advertising concerning health wares, etc.

He should be made to realize that in health practices no one regulation is an absolute requirement for everyone. Individuals vary greatly in their physical conditions; and intelligent action is necessary to meet such variations. The importance of periodical health examinations, and the need of procuring and following a doctor's advice should be strongly impressed upon him in this connection. When it comes to allergies and endocrinology, detailed knowledge is certainly not essential, since little knowledge of either is safely applicable by laymen. However, the adolescent should be made aware of the probable connection of these to his health, and be warned against advertising of drugs, and against self-medication in this connection. Again, he should be made to realize that the advice of a reliable physician is an absolute necessity.

WITH THIS brief survey[2] as to what personal living knowledge is essential to the present-day adolescent, our next problem is how to present the material so that effective reactions on the part of the learner may result.

[1] *Science in General Education*, op. cit., p. 86.
[2] For a more complete summary of needed health problems, refer to the final report of the North Central Association Experiment on *Functional Health Teaching* by L. M. Weber, being published by Ginn and Company.

Presenting Health Knowledge Effectively

Perhaps one of the most effective ways of presenting health knowledge is to use the problem approach. If the problem has significance in the adolescent's immediate and near future life, his interest is assured from the start. If, in the solution of such problems, facts are presented in a scientific fashion, his respect for its solution will be increased. If he is convinced that new or changed health practices on his part will improve his own health, the desired attitude will have been established. If the health teacher, together with the cooperation of the parents, will then as-

sist him in initiating and furthering his chosen habits and practices, our objectives will usually have been accomplished.

I. The Problem Approach.

After the director has determined what health topics need stressing in the course, he should begin to look for meaningful approaches. Frequently local situations afford such approaches. The following list will illustrate the method:

1. An outbreak of smallpox in a community affords an opportunity to present the entire problem of immunity in the health classes.

2. In many schools, tuberculosis tests are being administered periodically. The test might well be discussed and explained in the health classes just previous to the testing program. Many pupils, who might have been reluctant to take the test, will be willing to comply after they understand it.

This situation might open the way to a study of tests of other natures; such as, the Dick test for scarlet fever, the Shick test for diphtheria, tests for food and other allergies, etc.

3. At a time when national and state campaigns are being carried on, and publicity is at its height, the same problems can profitably be studied, in the health classes in high school. Much valuable printed matter is available at such times; furthermore, the high school pupil can be made to feel the importance of cooperating in problems of state or national character. The current drive to stamp out venereal diseases presents to health teachers an opportunity, if not a definite responsibility.

4. Physical examination reports invariably reveal that a certain number of pupils are underweight, others overweight, still others anemic. With this information known to the pupils and their parents, the approach to the study of diet is more personal, and therefore more effective.

5. Physical examination reports usually reveal that many boys and girls have symptoms of the beginning of foot trouble. This opens the way to the study of foot hygiene and posture in general.

6. The development of "athlete's foot" among boys raises the problem of environmental cleanliness; the development of impetigo in the school population, or an epidemic of boils in its football squad, raises the problem of personal cleanliness.

7. The beginning of an epidemic of colds or influenza opens the way to a study of the prevention and control of respiratory diseases.

8. The report of a case of partial or total blindness in a community, due to arsenate of lead poisoning, opens the way to the study of food and other poisonings in general, and of the laws needed to cope with the same.

9. The report of a death in the community due to an overdose of narcotic sleeping potions produced without a doctor's prescription opens the way to the study of drugs and narcotics, and of the laws needed to control their sale and usage.

10. Supposing a school has just procured a new swimming pool. This offers an opportunity for the study of sanitary water supplies, swimming pools and bathing beaches.

11. The report of a case of malaria, or an outbreak of rabies among dogs in the vicinity, prepares the way to a study of the prevention and control of insect and animal-borne diseases.

12. Reports of automobile accidents due to drunken driving present an opportunity to study the problem of the effects of alcohol on the human body, and the stressing of moderation or abstinence.

13. Authentic reports concerning discoveries as to uses of specific food-elements, immunizations, or the causes or cures of diseases hitherto uncontrollable, open the way to a study of scientific methods as used by recognized scientists.

(To be concluded)

Science Fusion And Mental Confusion

SHERMAN R. WILSON

Northwestern High School — Detroit, Michigan

WHAT IS WRONG with high-school science? For several years this question has been discussed by science teachers in all parts of the country. We all agree that our chemistry course needs revising, and, judging from the many articles we see in our current journals, the plight of physics is even worse. Yes, something is radically wrong. High-school science, in some parts of the country, is sick. It is afflicted with a mental disorder which is somewhat hysterical in its nature. Perhaps high-school science is suffering from a mild case of psychoneurosis. At any rate, I shall pose as a psychiatrist and try to diagnose the case. The approved procedure is, I believe, first to discover the cause, then to note the developments, and, finally, to suggest a cure.

After studying the history of science teaching I have come to the conclusion that the trouble started shortly after the turn of the century. Previous to this time, the chief aim of the high schools was to prepare students for college. The subject matter in physics, chemistry, and other high-school sciences was controlled by college entrance boards, and, in fact, most of the textbooks were written by college professors. Then came the revolt. At first only a few schools were bold enough to raise the cry for freedom, shouting, "Why should we let those college professors tell **us** what to do?" Perhaps this uprising was necessary, but, as is frequently the case, the period of adjustment has been one of disorder and confusion.

ANOTHER CAUSE which has contributed to the present sad mental state of our patient was the attempt to overthrow the "doctrine of formal discipline." This doctrine, as you know, is founded on a belief in the transfer of training. The proponents of this theory claim that any ability, such as the use of the scientific method, can be transferred from one field to another. Psychologists tells us that this is true only to a limited extent. For example, a good chemist may do a very poor job of applying the scientific method to a problem in economics or sociology.

Before this limiting feature was disclosed, many teachers believed that **discipline** was the chief aim of all science teaching, and that subject matter was of little importance. When the fact that the old methods were not perfect began to be recognized, there arose a demand for "functional" science, for subject matter that would be useful rather than abstract. But please do not misunderstand me. I am not arguing for or against the domination of the colleges or the doctrine of formal discipline. I am simply stating that the struggle to overthrow these forces has acted as a contributing factor to the present state of confusion, through which science in our secondary schools is now passing.

How has this condition developed? Fused-science courses have played an important part. The first step in this fusion process was taken about 1900 to 1905, when general science and biology were started. In the beginning, these sciences were formed by simply welding the older sciences together end to end. Biology consisted of a half-year of botany followed by a semester of zoology; and, in general science, some schools tried to teach all of the natural sciences one after the other.

IN THE SECOND step we see an attempt to fuse two or more sciences into one mass and call it a unit. In biology, flowers, grasshoppers, and elephants may be all mixed up and served together; and in some senior high-

school science textbooks we find astronomy, bacteriology, chemistry, and physics fused (or should I say confused) all in a single chapter.

As a third factor contributing to this disorder, I call your attention to certain widely advertised fused-science courses that are being offered for the consumer. In some of these consumer courses much emphasis is placed on such problems as how to buy a refrigerator, but, as a rule, scientific principles are considered to be of little importance.

The latest development is an attempt to fuse all of the subjects in the curriculum — English, mathematics, social studies, and the natural sciences — all into one unit. The advocates of this method call this scrambling process **integration** and refer to these so-called units or **core-subjects.** This trend has spread from New York to California or vice versa and, in some schools, this attempt at fusion is causing much confusion.

NOW THAT we have discussed the causes and have traced some of the developments of our diseased science teaching, the next step should be to suggest a cure. But, when we attempt to apply the remedy, we must keep in mind the patient's condition. We do not want a "blitzkrieg," or even a New Deal. We know that the effect of revolutions and sudden changes are often disastrous. Our plan for a cure should be simply this: let us save the good and discard the bad. First, we need a program.

This problem is not a new one. During the last decade plans for improving secondary-school science have been discussed in many parts of the country; several programs have already been proposed. Let us examine some of these programs and see what they have to offer.

IN NEW YORK, Dr. Knox, State Superintendent of Public Instruction, advocates the following: general science in grades 7, 8, and 9; general biology in grade 10; physics in grade 11; and chemistry in grade 12. He also mentions the need of a modified course for the slow-learning group. In this connection he makes some interesting comments on fused courses. I quote from Dr. Knox.

> 'Various experiments are being conducted with integrated physical-science courses that are designed to **replace** physics and chemistry. To advanced students and particularly to research workers who have been brought up through formal physics and chemistry and who are able to stand on a pinnacle of science knowledge, many integrations may appear to be possible; and, from their adult and advanced point of view, a survey or integrated type of science course may appeal as a royal road to learning. From this point of view (they say) it is not necessary for the learner to struggle through a maze of separately organized courses in physics and chemistry. Perhaps they forget that it was through this very process that they themselves have been able to reach the position where they can appreciate the integrations which appear at an advanced level. This artificial organization of subject matter is proposed as a substitute for the more traditional physics and chemistry. It is claimed that this organization is more psychological than the other. There is no evidence to support this contention.
>
> "It is by no accident that man has, through the last hundred years, or more, gradually organized bodies of knowledge that have come to be known as physics, as chemistry, or as the biological sciences. There is something very fundamental and natural in such an organization. Although this division of subject matter is so often damned as being traditional and out-of-date, it is possible that there still may be something very psychological about it. The organization of chemistry in terms of names of substances, occurrence, preparation, properties, and uses, has been criticized frequently. But it happens that this treatment is very similar to that discovered in questions of interest concerning any new product: What is it? What will it do? Where does it come from? and What is it good for? A typical chemistry course contains learning materials that seem to have a rather deep-seated appeal to most students. There is something fundamentally satisfying to maturing pupils in a definite organization of materials and the sound psychological classifications of scientific knowledge such as are found in our traditional physics and chemistry courses."

(Continued on page 32)

Scientific Belief, Attitude And Skill

PHILIP B. SHARPE

Greenwich High School — Greenwich, New York

THE DIFFICULTY we experience in determining scientific attitudes is possibly due to an unconscious and unwarranted assumption that a complete list of scientific attitudes would include all the desirable traits of a scientist. It might clarify the situation a little to classify the desirable traits of a scientist under three headings: beliefs, attitudes, and skills.

To avoid misunderstanding over mere nomenclature, let it be admitted at once that scientific beliefs, attitudes and skills, like many other traits, are both one and many. It is equally proper to speak of virtue or of virtues, character or characteristics, grace or graces, the first being more general and the latter more specific. Similarly, it is equally proper to speak in general of scientific belief, or attitude, or skill on the one hand, or to speak more specifically of the scientific beliefs, attitudes, and skills on the other.

It seems to the author that there can be only one general scientific belief, belief in scientific progress. There can be only one general scientific attitude, — a disposition to use scientific method and fact in solving problems. There can be only one general scientific skill, — skill in using the scientific method in solving problems. Each of these general traits is fundamental to the specific traits in its group.

THE SPECIFIC scientific beliefs, attitudes, and skills, however, are indeterminate in number, depending largely on how specific one wishes to be. The following tentative list of specific scientific beliefs appears to be fairly reasonable in length, that is, sufficiently specific for clear thought yet not excessively minute. It has some philosophical and psychological basis, also, as all the items are related to the scientist's general belief in scientific progress, and they seem to be the beliefs of professional scientists. The listed scientific attitudes are based on the scientist's general disposition to enlarge the application of science: and they seem, like the listed skills, to be the traits both necessary for successful scientific research and developed by that activity.

Scientific Belief

THE LIFE of a scientist is guided by a fundamental belief in scientific progress.

1. A SCIENTIST BELIEVES IN **CAUSE AND EFFECT**: that all results have causes.
2. A SCIENTIST BELIEVES IN **NATURAL LAW**: that the same causes will always produce the same results.
3. A SCIENTIST BELIEVES IN **APPLICATION**: that man can discover the relationships of cause and effect and apply them to progress.
4. A SCIENTIST BELIEVES IN **METHOD**: that any normal person can learn how to apply the scientific method and make discoveries.
5. A SCIENTIST BELIEVES IN **FREE-WILL**: that man can voluntarily change his actions and increase his success.
6. A SCIENTIST BELIEVES IN **FREEDOM**: that man can mature and progress only as far as social opportunities will allow, and that restrictions are justified only as far as they protect freedom.
7. A SCIENTIST BELIEVES IN **DEVOTION**: that the greatest joy comes to the man who leads a mature life dedicated to something far more important than himself.

Scientific Attitude

A SCIENTIST has an intense desire for experimental truth.

1. A SCIENTIST IS **INTERESTED**:

He is curious about the world around him and alive to its wonders of cause and effect.

2. A SCIENTIST IS **CAREFUL**: He is painstakng and persistent. He keeps trying after many failures.

3. A SCIENTIST IS **HONEST**: He is open and above-board with himself and others. He welcomes criticism of his work because it helps him make it correct.

4. A SCIENTIST IS **OPEN-MINDED**: He welcomes new ideas and evidences, especially those opposed to his own.

5. A SCIENTIST IS **SKEPTICAL**: He demands clear evidence for all ideas, especially his own.

6. A SCIENTIST IS **OPTIMISTIC**: He attacks difficult and sometimes dangerous problems. He often succeeds in doing things that "cannot be done."

7. A SCIENTIST IS **BRAVE**: He fights sham, show, and coercion which stifle progress.

Scientific Skill

WITH MUCH practice a scientist becomes very skillful in soling problems with the scientific method.

1. A scientist states problems simply, clearly, and objectively.
2. A scientist gathers indications diligently, selects them carefully, and evaluates them wisely.
3. A scientist considers all conceivable alternatives.
4. A scientist tests the most likely or the most feasible hypothesis first.
5. A scientist deduces consequences which can be tested by experiments.
6. A scientist devises ingenious experiments, performs them with care, and draws conclusions from them with strict logic.
7. A scientist realizes the great social value of his work.

IT IS THOUGHT that temporarily, at least, such lists will do fairly well in arousing the student's enthusiasm and in helping him to practice and acquire these valuable characteristics. But while

(Continued on page 35)

OPPORTUNITY KNOCKS LOUDER

(Continued from page 5)

a qualified electrician of practical experience. The course includes such practical features as the best methods of wiring homes, assembling motors, and using power efficiently. Equipment is provided that is adequate for the needs of the work required. Such courses will undoubtedly be of great value in preparing young men for better citizenship as well as to meet defense needs.

ALL THESE recent moves in education, whether directly or indirectly related to defense, present us a challenge in making the most of our opportunity to improve science courses in the direction of being vital. The National Committee on Science Teaching of the National Educational Association, now working out an improved and vitalized science course, believes that we are working in the right direction if we have as our objectives such outcomes as safety, better health, efficiency in the home, better buying of goods, preparation for a vocation, and an avocation, and the development of appreciations for the labor of others. What we teach should be judged on the basis of such vital outcomes as these.

Talking about vitalizing a science course and doing it, however, are two different things, as any teacher knows who tries to change his methods. It is much easier to continue without change. Ideas are needed. Science teachers' journals should be examined to learn what others are doing and thinking. For publication in THE SCIENCE TEACHER we are always in search of useful material of this type. We are always glad to receive from active teachers a discussion of the methods and materials they consider useful in vitalizing a science course.

We need to keep constantly in mind that opportunity for improving science instruction is not only knocking at the door of every science teacher, but is knocking louder than before and must be heard. Why not open wide the door?

RADIO DEMONSTRATIONS

(Continued from page 17)

4. Radio waves must cut the antenna to induce current.

RADIO RECEPTION

INSTEAD OF using a neon tube as a visual indicator of radio reception, we may employ a radio tube to give actual sound reception. A crystal set can also be used for sound reception, but ear phones instead of a loud speaker must be used.

Apparatus

The apparatus consists of one spark coil transmitter as in the previous demonstration, one receiving antenna, one radio tube (01A), four dry cells, and one magnetic loud speaker. The method for assembling the apparatus for the radio receiver is shown in the diagram (Fig. 2).

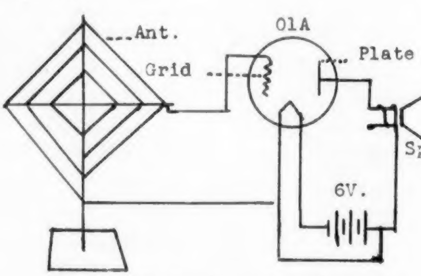


Fig. 2. Radio Reception Apparatus

Operation

1. Adjust the spark gap as small as possible.
2. Connect the speaker directly across the receiving antenna. Depress the key. No sound is heard.
3. Now connect the radio tube as indicated above. Depress the key. A signal is now heard.

Outcome

A radio tube makes it possible to receive a sound signal.

FUNCTION OF A CONDENSER

IN ORDER TO show the function of a condenser a neon two watt tube and a variable radio tuning condenser are connected in series with the receiving antenna as indicated in Fig. 2. The condenser should be of 350 MMF capacity

(Continued on page 36)

NARST Program

FOURTEENTH ANNUAL MEETING

Atlantic City, New Jersey February 22-26, 1941

Saturday, February 22, 1941

Joint Luncheon Meeting with National Council on Elementary Science. Hotel Traymore.

12:15 Luncheon.

1:30 THE SIGNIFICANCE OF SOME ESSENTIALS FOR ACCURATE THINKING FOR ELEMENTARY SCIENCE INSTRUCTION, George W. Haupt, State Teachers College, Glassboro, N. J.

2:30 CHILDREN'S EXPLANATIONS OF NATURAL PHENOMENA. Mervin Oakes, Queens College, Flushing, N. Y.

3:30 Business Meeting — NCES.

Note: A television demonstration is to be given in the Auditorium, Saturday evening, sponsored by the Department of Secondary Education of the N.E.A. The members of our organization are invited to attend this demonstration.

Sunday Evening, February 23, 1941

West Room, Claridge Hotel Harry A. Carpenter, Presiding

6:30 Dinner meeting. Members only.
Presidential address.
Business meeting. Report of committees.

Monday, February 24, 1941

Morning Session, East Room, Hotel Claridge
Harry A. Carpenter, Presiding

9:00 Business meeting.

10:00 Meeting of Area Committees.

12:15 Luncheon. Members are invited with the Department of Secondary Teachers of N.E.A. and Association of Technical High Schools and Institutes, Ambassador Hotel. Speaker: Harry Carpenter.

Afternoon Session, East Room, Hotel Claridge G. P. Cahoon, Presiding

2:15 NEEDED RESEARCH IN SCIENCE EDUCATION. A. N. Zechiel, Curriculum Consultant, Committee on Relation of Schools and Colleges, Progressive Education Assn.

3:00 Panel on THE SCIENCE WORKSHOP: ITS PURPOSE, METHODS, AND EFFECTIVENESS.
W. C. Croxton, State Teachers College, St. Cloud, Minn.
J. Wallace Page, Director Maryland Academy of Sciences, Baltimore, Mr.
A. O. Baker, Chairman High School Science Curriculum Center, Cleveland, Ohio.
Clark W. Horton, Dartmouth College, Hanover, N. H.
E. A. Waters, University of Tennessee, Knoxville, Tenn.
O. S. Loud, Bureau of Educational Research in Science, Columbia University, New York City.

4:15 Discussion from the floor.

6:00 Dinner meeting of Executive Committee.

5:00 to 10:00 Open time for meetings of Area Committees.

Tuesday, February 25, 1941

Morning Session, Picadilly Room, Hotel Claridge G. P. Cahoon, Presiding

9:00 Reports and recommendations by Chairman of the Five Area Committees. Discussion led by the General Chairman, Francis D. Curtis.

10:00 EVALUATION OF BROADCASTS AND RECORDINGS FOR THE CLASSROOM. J. R. Miles, Bureau of Educational Research, Ohio State University.

11:15 Discussion.

12:30 Luncheon at the convenience of members. It is suggested that the area groups arrange to have luncheon together.

Afternoon Session, Solarium, Hotel Claridge
Harry A. Carpenter, Presiding

2:00 EXPERIENCES WITH A JUNIOR ACADEMY OF SCIENCE, E. S. Obourn, John Burroughs School.

2:45 Discussion.

3:15 Reports from N.A.R.S.T. members on the National Science Committee, led by Ira C. Davis.

4:00 Business meeting.

6:30 Dinner. Suggest group dinners by the five Area Committees to consider procedures for the following year. Claridge Hotel.

SCIENCE FAIR

(Continued from page 8)

garments. One of their most interesting demonstrations was that of the steam-electric iron.

At eight-thirty all shows were closed (several under protest). The visitors assembled in our large auditorium. Since this was our school's only public celebration of National Education Week, it was decided to include patriotism as part of our program. A short flag ceremony was presented by the Boy Scouts who were members of our department. A verse speaking choir program was given by the Home Economics and Vocational Science clubs.

The final attraction and the highlight of the evening was a liquid air demonstration by Professor Knipp, who does this as a hobby. This concluded the very active program and to say that the club was satisfied would be putting it mildly. They were truly inspired and very happy about their day's program.

Tickets

FUNDS ARE always necessary to successful activity in any club. The financing of the fair was handled by our treasurer. About ten days before the event, tickets were given to each member of the club. The tickets were twenty-five cents.

(Continued on page 36)

SCIENCE FUSION

(Continued from page 25)

I THINK Dr. Knox has hit the nail on the head. And I am proud to state that we also have something to offer along the line of his recommendations. Here in Detroit a twelve-year science program is now being developed. In the first six grades, the aim is to give the pupils experiences that lead to "major generalizations." In the junior high school, we teach general science. At this level generalizations are stated in more precise terms as scientific laws and principles. And, in the senior high schools a two-way program is offered; one for the college-preparatory students and the other for the general group. The college-preparatory students take the standard science courses including laboratory work. We recommend biology in the 10th grade, chemistry in the 11th, and physics in the 12th grade. The slower pupils may elect general biology in the 10th grade and descriptive chemistry and physics in the 11th or 12th grades.

In these descriptive courses we study the everyday applications of science. Pupils are not required to learn valences, to balance equations, nor to solve difficult mathematical problems. But please note that we have not confused our sciences by attempting to fuse them; chemistry and physics are offered as separate sources. It is my opinion, however, that in eliminating laboratory work for the noncollege group, we have made a serious mistake. This group needs the concrete experiences that laboratory work gives, even more than do college-preparatory students. Slow-learning pupils, as a rule, do not read above the sixth grade level. They learn more readily by doing; personal activity is essential to their growth.

(Continued on page 33)

SCIENCE FUSION

(Continued from page 32)

WE ARE recognizing this need, and are now preparing some simple experiments in chemistry and physics for a course that might be called a work shop in science. This course should appeal to the ultimate consumer. In the laboratory, pupils are given an opportunity to test some materials commonly found in the home, such as foods, drugs, clothing, and cleaning agents. They may also learn how to prepare ointments, hand lations, hair dressings, and other cosmetics. This work is practical. However, the aims of a true science course in chemistry and physics are not neglected; fundamental principles are applied and the scientific method developed by doing experiments that are interesting and useful rather than experiments that are designed merely to prove laws and theories.

In Detroit, we are also modifying our college preparatory courses. Committees appointed by Mr. Massey, our supervisor, have written and rewritten our laboratory manuals until we think they are good. And when we adopt a modern chemistry textbook that fits in with our plan "to save the good and discard the bad," we shall be well fortified.

Finally, as a cure for the schools that have been confused by the fused sciences, we recommend that you give our Detroit plan a trial.

OPPORTUNITY IN JUNIOR ACADEMY

(Continued from page 9)

this field has extraordinary possibilities for a valuable up-to-the-minute notebook.

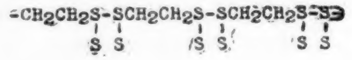
The Science News Letter offers much possibility for cooperative work on the part of the entire science club. Individual members may exercise special talents through the medium of feature arti-

(Continued on page 38)

SYNTHETIC RUBBER

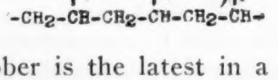
(Continued from page 3)

bon solvents. This last property, the refusal to imbibe solvents, is principally responsible for its contined development and its replacement of rubber in such connections. It has been used, although in small quantities, in many other ways, but its use in tires seems unlikely at present. The same is true of Thiokol, which is also a solvent resistant rubber substitute which has maintained a small continuous sale for about ten years. It is not exactly related to the rubbers, since it is prepared from ethylene dichloride and sodium polysulfide (actually principally tetrasulfide) and hence has a carbon-sulfur polymer chain as in (IX). The raw materials are refinery gases, salt, and sulfur. From the salt

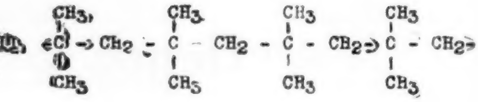
IX.


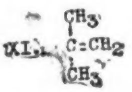
comes both chlorine, which with ethylene gives the dichloride, and the caustic which is the starting point for the polysulfide solution.

ANOTHER NEW polymer, Koroseal, is also unrelated to rubber. It is a plasticized polyvinyl chloride (X) which finds some use in solvent and corrosion resistant positions. It is made chiefly from coal and limestone (for acetylene) and salt (for hydrochloric acid). The most important of the new developments, however, concern those polymers which may be useful for tires. Two of these show particularly great promise. One of them is Butyl rubber, and the other is Ameripol.

X.


Butyl rubber is the latest in a family of synthetic rubber-like materials which began with the development of Vistanex. The latter is a polymer of isobutylene (XI), a monomer potentially available in huge quantities from petroleum cracking. The structure of the polymer (XII), however, is that of a saturated

XII.


XI.


hydrocarbon. Consequently, it can not be subjected to vulcanization in the usual fashion, and its properties are not precisely those required for use in tires. The nature of Butyl rubber has not yet been disclosed, but it is probably a relative of polyisobutylene. If its properties are as valuable as they promise to be, this material may well present an economic threat to natural rubber.

Ameripol is a copolymer of butadiene and some other olefinic derivative which has not been announced. It has already been used in experimental tire production, and may soon appear on the general market. In chemical structure it is a relative of the Buna rubbers.

THE CONCLUDING feature of the present scene is the development of American plants for the production of the modified Buna rubbers. It has been reported that this is now well under way. The required monomers can all be produced in very large quantities at a relatively low cost, and the processing methods are being perfected.

These two developments, particularly Butyl Rubber, and the American manufacture of Buna rubbers, may spell the beginning of the end for natural rubber as essential commodity. One by one the necessary steps are being taken. It was first a question of finding cheap monomers. When that probleb succumbed under the attack, the method of polymerization was investigated, and emulsion polymerization and copolymers were the result. It remains now to study the art of processing the materials to bring out their best qualities. Research on all these fronts has always been, and still is, a very necessary thing; none of the aspects may be neglected. But the

future lies chiefly in the development of methods for quantity manufacture and in the preparation of copolymers designed to bring out specific polymer properties. With the present emphasis placed on rubber as an economic and military necessity, it has been estimated that natural rubber could be replaced in two years by a suitable but costly program. Unless this development is forced, it is probable that the process will be considerably slower. However, it is not impossible that some time in the future natural rubber will slip from its present important economic place to a relatively minor position, and that its place will be taken by the synthetics.

SCIENTIFIC BELIEF

(Continued from page 27)

for testing purposes, it is of course highly important that any list of scientific traits finally adopted be as accurate as may be, there are strong apriori grounds for believing that for teaching purposes it matters very little that accuracy be attained in such a list. It is probable that one does not acquire the beliefs, attitudes, and skills of a scientist by memorizing them. It is probable that one acquires the traits of a scientist by becoming a scientist, that is, by doing original research work; just as one acquires the traits of a manager of real estate, not by study, but by managing real estate, or the traits of a speculator by speculating, the traits of a criminal by committing crimes, the traits of a Christian by following Christ. It works both ways, no doubt; the traits promote the activity and the activity promotes the traits; but one can commence the activity by an act of will and so acquire the characteristics that accompany that activity.

The inculcating and instilling of the general or fundamental scientific attitude, skill, and belief by means of making practicing amateur scientists of our students, is then, sufficient goal for teaching purposes. If these analogical

(Continued on page 40)

THE CARBON ARC

(Continued from page 12)

that they sparkle like Fourth-of-July sparklers.

Incidentally, the apparatus gets its name from the path of the bluish-white light which crosses the gap, not directly, but in a wide arc between the carbons.

Because the light rays given off are mostly ultra-violet and three-quarters invisible, a close relative, the Cooper-Hewitt mercury arc lamp finds much usage in hospitals, for killing bacteria

THE ARC is not a true flame, for there is little combustion. Since there is so little combustion, the arc will continue to work under water, but with diminished light and heat. However, the water surrounding the arc is disintegrated into hydrogen and oxygen gases which rise to the surface in large bubbles.

Today, the usage of the arc varies between lighting and heating. Lighthouses, giant search lights, and motion picture machines still use the carbon arc for maintaining bright lights. On clear nights powerful arc light beams can be seen at a distance of thirty to forty miles. Commercial production of some alloys of steel requiring high temperatures use giant arc furnaces in manufacturing.

Looking into the future, it is possible that arc furnaces might be used to heat and light rooms, yes, perhaps even houses. By using brightly polished reflectors, heat and light would be radiated to all parts of the room. There will be many more uses found for this particular kind of furnace, for who knows what the future has in store.

The carbon arc as I have tried to show has been useful in the past, become valuable at present, and will find more and better uses in the future.

For publication — We need articles dealing with projects, demonstrations and methods of teaching units of subject matter. Send them to Editor of The Science Teacher

RADIO DEMONSTRATIONS

(Continued from page 28)

(broadcast band). A radio spark transmitter as previously described is also required for this demonstration.

Operation

1. Connect the condenser in parallel with the receiving antenna.
2. Press the transmitter key with the condenser plates open. The neon bulb lights dimly.
3. Repeat with the condenser plates

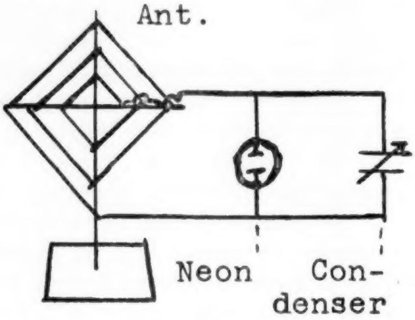


Fig. 3

closed. The neon bulb glows brightly.

Outcome

A radio condenser is used to tune in a radio wave signal.

SCIENCE FAIR

(Continued from page 31)

The tickets were printed in such a way that each attraction could be attended only once, in other words, there was a number for each attraction and each ticket holder was permitted to see as many exhibits as time permittd, but no attraction more than once. Our tickets were printed by a member of our club; our decorations were made by our members; our major expense was for the materials used for the Liquid Air Demonstration. We were very fortunate to have these given us at less than cost by our benefactor, Professor Knipp.

After the fair we interviewed "the man in the street" and found that he would have preferred fewer attractions so that he could have seen them all. The most popular attraction was, of course, glass blowing.

The Gist of It Seems to Be

Abstracts and Reference

How to dissect and demonstrate a beef heart.—Helen I. Battle, "Biology Through the Abattoir," in Am. Biol. Teach., Nov., 1940. P. B. S.

* * *

Divide your students into ability classes and give each group what it needs in the way it needs it.—Melvin A. Hintz, "A Modern Biology Program for the High School," in Am. Biol. Teach., Nov., 1940. P. B. S.

* * *

How to make and use an apparatus to show the nature, rate and effect of chemical substances on the fermentation of yeast.—Harold M. Kaplan, "A Teaching Aid . . . ," in Am. Biol. Teach., Nov., 1940. P. B. S.

* * *

Instead of a compulsory lab. or work book, how about a one-year project required only for honor grades? Claude I. Hoffman and Dora Peterson, "Teaching Biology by the Project Method," in Am. Biol. Teach., Nov., 1940. P. B. S.

* * *

To promulgate scientific attitude we emphasize biographical research on living biologists. We realize that our students now believe that biological knowledge comes after much hard work.—Joseph B. Sommer, "Human Interest in High School Biology," in Am. Biol. Teach., Nov., 1940. P. B. S.

* * *

In favor of a completely fused curriculum.—Philip G. Johnson, "The Sciences Need the Social Studies," in S. S. & M,. Nov., 1940. P. B. S.

* * *

We must, I think, admit the validity of the chief critcisms of teacher education, and among the others,—that the vested interests of Teachers Colleges overstress History, Principles, General Methods, and use certification agencies to force large numbers of teachers to attend them. And we must, I think, admit that our graduates are poorly trained for their work. However, the aforementioned shortcomings (lack of coherent world picture, etc.) when stated positively, may be considered to be objectives.—Samuel R. Powers, "On the Responsibilities of Teachers with Special Training in Science," in S. S. & M., Nov., 1940. P. B. S.

* * *

A short clear advertisement of Bryan's Valence Blocks.—A. H. Bryan, "Valance Blocks Visualize High School Chemistry Fundamentals," in S. S. & M., Nov., 1940. P. B. S.

* * *

A thorough and sensible review.—Sister Mary Martinette, "The Presentation of Atomic Structure to College Freshmen, 1905-1940," in S. S. & M., Dec., 1940. P. B. S.

* * *

If high school science courses are not to disappear from the picture entirely, they must cease and reverse their present ridiculous trend toward generalization in this increasingly specialized world, and become specialized again. But not in the old way, in a useful way. They must work hand in hand with local industry and agriculture, to solve actual problems in training and operation.—Paul V. Beck, "Science Serving the Student," in S. S. & M., Dec., 1940. P. B. S.

* * *

A Texas science teacher, Gilbert Wilson, with his Science Club, has developed a grinder and press of tremendous importance to the sweet potato industry of the whole region. Is this not a challenge to all of us?—Carrol C. Hall, "A Science Club That Had a Future," in S. S. & M., Dec., 1940. P. B. S.

(Continued on page 40)

OPPORTUNITY IN JUNIOR ACADEMY

(Continued from page 33)

cles, drawings, diagrams, editorials, plays, and discussions. By working together, students may keep an accurate and permanent record of their joint efforts. The Illinois Junior Academy maintains an exchange among its school members. In this way pupils of one school may read and learn of interesting activities and projects being practiced in other schools of the state.

Posters lend themselves readily to visual education. Their appeal helps to focus attention on a subject through a new and stimulating channel. For the student, posters afford a welcome means for displaying the results of any creative ability that he may have.

By means of collections, members or individuals in the class can discover products of their science in the environment about them. Through this stimulated activity, a better organization will result.

Finally, at the annual exhibit of the Junior Academy of Science, these learning devices are exhibited for all to see at one time. The whole panorama of science and its possibilities in the high school present an occasion that every school boy and girl can not afford to miss!

FREE MATERIALS

(Continued from page 16)

The National Youth Administration has prepared, under the supervision of Dr. Charles H. Judd, a series of booklets called "The Modern World at Work" which are used in the recently established N. Y. A. schools. Science teachers will be interested in the following numbers:

No. 1 Electricity
No. 2 Standards
No. 3 Agriculture
No. 4 Roads
No. 5 Automobiles
No. 6 Weather

All booklets are excellently and profusely illustrated and contain approximately 50 pages. Price 15c each.

BOOK SHELF

The Why of Qualitative Analysis. Alfred M. Ewing, Texas Wesleyan College, Forth Worth, Texas. Revised edition. Published by the author, 1940. 43 pp. Many diagrams. $1.00 net.

The Why of Qualitative Analysis by Professor Ewing, is designed particularly for college freshmen chemistry students to give them a clearer understanding of what is happening as each step of the qualitative analysis procedure is carried out, and to give a simple mental picture of the scheme of analysis. The book is also adapted to the use of advanced and more capable high-school students who desire experience in qualitative analysis as a chemistry project or advanced work.

The book is unique in that the plan of analysis is indicated by a series of diagrams (e.g., a funnel is used to indicate filtration) that help the student to get a mental picture of the procedure. With each diagram is indicated the test to be used and the possible results. The diagrams provide the background for making effective the accompanying questions and answers applying to the procedure. A complete chart giving the diagrammatic scheme of analysis of all five groups is also included.

The most important feature of the book is the questions raised about every step in the procedure and the clear-cut answers given. There can be no doubt but that a student who will think through the process as directed by these questions will be a more intelligent and efficient workman. He will be in a position to judge the amount of chemicals used in any step or the amount of washing required without relying on a fixed, rule of thumb procedure. The questions and answers are arranged on the page adjoining the diagram of analysis, thus enabling the student to visualize each step as he does his thinking.

A Study-Book for Everyday Problems in Science (third edition) by Dr. W. L. Beauchamp of the University of Chicago; John C. Mayfield, University High School, Chicago; and J. Y. West, Maryland State Teachers College, Townson, Maryland. 340 + VI pages, 84c list. Scott, Foresman and Company.

"This Study-Book was made to help you do a good job in your study of the science of the world you live in. It will show you quickly and definitely whether you know the facts and whether you understand the ideas in your science book, Everyday Problems in Science. If you can correctly answer the questions and do the other work in this Study-Book, you may be sure that you are learning the science you should know. If you fail on one of these exercises, you have slipped somewhere. Go back to your textbook again and dig out the correct facts, or ask your teacher for help if you cannot seem to "get" the idea. This Study-Book is your self-test; it is your check on yourself . . . "

The above quotation from the Preface to Pupils describes pretty well this new-type Study-Book written by the authors of Everyday Problems in Science for pupils using the text. In addition to the scores of different types of exercises, problems and illustrations, the Study-Book introduces a new teaching technic — the use of three types of exercises to meet different learning needs or situations. The first type of exercise covers the bare essential material in the textbook. The second type calls for some thinking and careful study of the reading material, pictures, and experiments. The third requires even more thinking and provides the pupil with an opportunity to apply scientific principles he has learned. Each type is marked for recognition. Teachers should welcome this extremely helpful provision for individual learning needs in the classroom.

Living Chemistry, by Ernestine M. J. Long, Normandy High School, St. Louis, Missouri. 70 pp., illustrated, planographed, published by the author.

"The material in this book has been arranged so that it may be used with any chemistry text. It attempts to correlate major understandings based on subject matter with scientific attitudes.

(Continued on page 40)

THE GIST OF IT

(Continued from page 37)

How to make good and uniform drawings of atoms using coins, washers, eight-sided, six-sided, and four-sided nuts.— Philip B. Sharpe, "Easy Atomic Drawings," in S. S. & M., Dec., 1940. P. B. S.

* * *

John Stewart Mill's Canons of Inductive Logic, often called The Canons of Science, though many and involved, do in actual practice boil down into one simple canon, of great use in teaching scientific method.— Philip B. Sharpe, "A Critical Analysis of the Canons of Science," in The Philos. of Science, April, 1940. P. B. S.

* * *

A good science unit.— Vivian I. Cord, "The Sun: A Unit for the First Grade," in Sc. Ed., Nov., 1940. P. B. S.

* * *

The new orientation in the field of secondary education does not find it essential to fit the child to the subject matter, but rather requires that the educator study the child, not out of relationship to his environment, but rather in terms of his evolvements with the culture in which he grows as an active dynamic organism that grows in interaction with a dynamic environment." — Harold H. Loudin, "Industrial Processes of Local Industry to Vitalize a General Science Program," in Sc. Ed., Nov., 1940. P. B. S.

* * *

A very useful article, — just what the title implies.— Conrad C. Pressey, "Guide to the Literature of Junior High School Science," in Sc. Ed., Nov., 1940. P. B. S.

BOOK SHELF

(Continued from page 39)

The author has attempted to take a middle of the road point of view drawing heavily from the 31st Yearbook and the Thayer Reports. . . . The claim is made that this course actually meets, in terms of specific classroom situations, the general objectives set forth in the 31st Yearbook. In cases where in organization of materials the subject matter understandings or concepts conflicted with scientific method understandings, the scientific method was given the preference.

The pattern retains the good features of the daily assignment plan and at the same time enables a pupil to be challenged by the full block of material in an area. The pupil with the teacher may organize the material in the area. This tends to establish a feeling of ownership in the pupil toward the working assignment. By organizing his own material and time budgeting the work, the pupil is also given a sense of direction and is stimulated to develop systematic study habits. The work has been disorganized in some areas to enable the pupil to fit the pieces together and see the whole pattern. . . . The experiments have been written to stimulate the pupil to use consciously the scientific method with safeguards."

The quotation given above from the preface by the author seems to sum up the material as presented in the work book. The student is given encouragement and some direction in entering upon the study of a unit of work. The experiments are presented so as to provoke thinking. The student must formulate his own objective from a study of the experimental material and also draw his own conclusion. The book is unique in method and worthy of examination by every chemistry teacher.

SCIENTIFIC BELIEF

(Continued from page 35)

considerations lead us to the truth, the specific scientific beliefs, attitudes, and skills, (whatever they may eventually be called in psychological analysis) are at any rate attributes of the scientist and so are part and parcel of the same goal and will be attained with it by making amateur research scientists of our students.

(Continued next issue)